

WHAT IS CLAIMED IS:

Sub B1
1 1. An ink jet recording apparatus, comprising:
2 at least one main tank, which stores ink therein; and
3 a plurality of sub tanks, communicated with each main tank, each
4 sub tank storing ink supplied from the main tank, and being communicated with
5 at least one recording head.

1 2. The ink jet recording apparatus as set forth in claim 1, wherein a
2 plurality of main tanks are provided.

1 3. The ink jet recording apparatus as set forth in claim 1, wherein the
2 sub tanks are arranged in a vertical direction.

1 4. The ink jet recording apparatus as set forth in claim 1, wherein each
2 sub tank is airtightly formed by a material having flexibility so that a volume of
3 the sub tank is variable.

Sub B2
1 5. The ink jet recording apparatus as set forth in claim 1, further
2 comprising:
3 a first ink amount detector, which detects an ink amount stored in
4 each sub tank; and
5 a first supply amount controller, which controls a supply amount of ink
6 flowing into each sub tank, based on the detection of the first ink amount
7 detector.

1 6. The ink jet recording apparatus as set forth in claim 5, wherein the
2 first supply amount controller is provided as a first valve member.

1 7. The ink jet recording apparatus as set forth in claim 6, wherein:
2 the first valve member is opened when the first ink amount detector
3 detects an ink low state in which the ink amount stored in the subtank is a first
4 predetermined level or less; and

5 the first valve member is closed when the first ink amount detector
6 detects an ink full state in which the ink amount stored in the subtank is a
7 second predetermined level or more.

1 8. The ink jet recording apparatus as set forth in claim 1, wherein the
2 subtank is communicated with a plurality of recording heads.

1 9. The ink jet recording apparatus as set forth in claim 1, wherein the
2 main tank and the subtanks are arranged so as to provide a head difference
3 therebetween, to supply ink from the main tank to the subtanks.

1 10. The ink jet recording apparatus as set forth in claim 1, wherein the
2 main tank is compressed to supply ink to the subtanks.

1 11. The ink jet recording apparatus as set forth in claim 10, wherein the
2 main tank is compressed by a pump member.

1 12. The ink jet recording apparatus as set forth in claim 11, wherein the
2 pump member is connected to the main tank via an air releaser which opens
3 the main tank to atmosphere.

1 13. The ink jet recording apparatus as set forth in claim 6, further
2 comprising a second supply amount controller, which controls a supply amount
3 of ink flowing out of the main tank.

1 14. The ink jet recording apparatus as set forth in claim 13, wherein the
2 second supply amount controller is provided as a second valve member.

1 15. The ink jet recording apparatus as set forth in claim 14, wherein the
2 second valve member is first opened while the main tank is compressed, and
3 then the first valve member is opened to supply ink to the subtank.

1 16. The ink jet recording apparatus as set forth in claim 14, wherein the
2 first valve member is first closed and the compressing of the main tank is
3 canceled when the subtank is replenished, and the second valve member is
4 then closed.

1 17. The ink jet recording apparatus as set forth in claim 4, wherein each
2 subtank contains a plate member which prevents inner surfaces of the subtank
3 from being adhered with each other.

1 18. The ink jet recording apparatus as set forth in claim 17, wherein
2 grooves are formed on surfaces of the plate member.

1 19. An ink jet recording apparatus, comprising:
2 at least one main tank, which stores ink therein;
3 a plurality of recording sections, communicated with each main tank,
4 each recording section including a subtank which stores ink supplied from the
5 main tank, and at least one recording head communicated with the subtank;
6 and
7 a system controller, which controls the main tank and the recording
8 sections such that a recording section in which a time period required for
9 supplying ink from the main tank to the subtank is shorter is controlled with a
10 higher priority.

1 20. The ink jet recording apparatus as set forth in claim 19, wherein a
2 recording section in which a path length connecting the main tank and the
3 subtank is shorter is controlled with a higher priority.

1 21. The ink jet recording apparatus as set forth in claim 19, wherein each
2 subtank is airtightly formed by a material having flexibility so that a volume of
3 the subtank is variable.

1 22. The ink jet recording apparatus as set forth in claim 19, further
2 comprising:
3 a first ink amount detector, which detects an ink amount stored in

4 each subtank; and

5 a first supply amount controller, which controls a supply amount of ink
6 flowing into each subtank, based on the detection of the first ink amount
7 detector.

1 23. The ink jet recording apparatus as set forth in claim 22, wherein the
2 first supply amount controller is provided as a first valve member.

1 24. The ink jet recording apparatus as set forth in claim 23, wherein:
2 the first valve member is opened when the first ink amount detector
3 detects an ink low state in which the ink amount stored in the subtank is a first
4 predetermined level or less; and

5 the first valve member is closed when the first ink amount detector
6 detects an ink full state in which the ink amount stored in the subtank is a
7 second predetermined level or more.

1 25. The ink jet recording apparatus as set forth in claim 19, wherein the
2 main tank and the subtanks are arranged so as to provide a head difference
3 therebetween, to supply ink from the main tank to the subtanks.

1 26. The ink jet recording apparatus as set forth in claim 19, wherein the
2 main tank is compressed to supply ink to the subtanks.

1 27. The ink jet recording apparatus as set forth in claim 26, wherein the
2 main tank is compressed by a pump member.

1 28. The ink jet recording apparatus as set forth in claim 27, wherein the
2 pump member is connected to the main tank via an air releaser which opens
3 the main tank to atmosphere.

1 29. The ink jet recording apparatus as set forth in claim 23, further
2 comprising a second supply amount controller, which controls a supply amount
3 of ink flowing out of the main tank.

1 30. The ink jet recording apparatus as set forth in claim 29, wherein the
2 second supply amount controller is provided as a second valve member.

1 31. The ink jet recording apparatus as set forth in claim 30, wherein the
2 second valve member is first opened while the main tank is compressed, and
3 the first valve member is then opened to supply ink to the subtank.

1 32. The ink jet recording apparatus as set forth in claim 30, wherein the
2 first valve member is first closed and the compressing of the main tank is
3 canceled when the subtank is replenished, and the second valve member is
4 then closed.

1 33. The ink jet recording apparatus as set forth in claim 21, wherein each
2 subtank contains a plate member which prevents inner surfaces of the subtank
3 from being adhered with each other.

1 34. The ink jet recording apparatus as set forth in claim 33, wherein
2 grooves are formed on surfaces of the plate member.

1 35. A method of controlling the ink jet recording apparatus as set forth in
2 any one of claims 19 to 34 to record information on a recording medium with
3 ink.

1 36. A method of initially filling a subtank with ink stored in a main tank
2 which is communicated with the subtank, comprising the steps of:

3 a) applying negative pressure to a recording head communicated
4 with the subtank, to discharge air in the subtank while compressing the
5 subtank;

6 b) opening a valve member provided between the main tank and the
7 subtank, after the step a), to supply ink from the main tank to the subtank;

8 c) closing the valve member after the step b);

9 d) applying negative pressure to the recording head, after the step
10 c), to discharge air and ink in the subtank while compressing the subtank; and

11 e) opening the valve member, after the step d), to supply ink from
12 the main tank to the subtank.

1 37. The initial filling method as set forth in claim 36, further comprising:

2 f) closing the valve member, after the step e);

3 g) applying negative pressure to the recording head, after the step f),
4 to partly discharge ink in the subtank; and

5 h) opening the valve member, after the step g), to supply ink from

6 the main tank to the subtank.

1 38. The initial filling method as set forth in claim 36, further comprising:

2 f) closing the valve member, after the step e); and

3 g) applying negative pressure to the recording head, after the step f),
4 to supply ink from the subtank to the recording head.

1 39. A method of initially filling a subtank with ink stored in a main tank
2 which is communicated with the subtank, comprising the steps of:

3 a) applying negative pressure to a recording head communicated
4 with the subtank, to discharge air in the subtank while compressing the
5 subtank;

6 b) opening a valve member provided between the main tank and the
7 subtank, after the step a), to supply ink from the main tank to the subtank;

8 c) closing the valve member after the step b); and

9 d) applying negative pressure to the recording head, after the step
10 c), to supply ink from the subtank to the recording head.

1 40. The initial filling method as set forth in claim 36, wherein the steps c)
2 to e) are repeated.

1 41. An ink jet recording apparatus in which the initial filling method as set
2 forth in claims 36-40 are performed.

1 42. The ink jet recording apparatus as set forth in claim 41, wherein the
2 main tank is located below the subtank while being compressed.

1 43. The ink jet recording apparatus as set forth in claim 41, wherein the
2 main tank is located above the subtank.

1 44. The ink jet recording apparatus as set forth in claim 41, wherein:
2 the subtank is airtightly formed by a material having flexibility so that a
3 volume of the subtank is variable; and
4 the subtank contains a plate member which prevents inner surfaces
5 of the subtank from being adhered with each other.

1 45. An ink supply system, comprising:
2 at least one main tank, which stores ink therein;
3 a plurality of recording heads, communicated with each main tank
4 while providing a head difference therebetween; and
5 a system controller, which monitors an ink amount consumed in each
6 recording head to manage a residual ink amount in the main tank.

1 46. An ink supply system, comprising:
2 at least one main tank, which stores ink therein;
3 a plurality of sub tanks, communicated with each main tank, each
4 subtank communicated with at least one recording section; and
5 a system controller, which monitors an ink amount consumed in each
6 subtank to manage a residual ink amount in the main tank.

1 47. The ink supply system as set forth in claim 46, wherein each subtank
2 is airtightly formed by a material having flexibility so that a volume of the
3 subtank is variable.

1 48. The ink supply system as set forth in claim 46, wherein the system
2 controller starts to count the consumed ink amount of the subtank when an ink
3 amount stored in the subtank becomes a predetermined level.

1 49. The ink supply system as set forth in claim 48, wherein the system
2 controller regards a total ink amount consumed in all the subtanks as an ink
3 amount consumed in the main tank.

1 50. The ink supply system as set forth in claim 46, wherein the system
2 controller obtains the consumed ink amount of each subtank every time when
3 the subtank is replenished with ink supplied from the main tank.

1 51. The ink supply system as set forth in claim 46, wherein the system
2 controller selectively supplies ink to at least one subtank which requires an ink
3 replenishment, and obtains the consumed ink amount of the at least one
4 subtank.

1 52. The ink supply system as set forth in claim 46, wherein the system
2 controller obtains the consumed ink amount of each subtank, and supplies ink
3 to all the subtanks simultaneously.

1 53. The ink supply system as set forth in claim 46, wherein a flow rate of
2 ink flowing into the subtank is greater than a flow rate of ink flowing out from
3 the recording section associated with the subtank.

1 54. The ink supply system as set forth in claim 46, wherein the system
2 controller starts to supply ink to the subtank when the ink amount consumed in
3 the subtank exceeds a threshold level.

1 55. The ink supply system as set forth in claim 54, wherein the threshold
2 level includes a first threshold level selected while the recording section
3 performs recording, and a second threshold level which is smaller than the first
4 threshold level selected while the recording is not performed.

1 56. The ink supply system as set forth in claim 46, wherein:
2 each subtank is provided with at least one detector which detects a
3 residual ink amount therein; and
4 the system controller starts to supply ink to the subtank when the
5 detector detects that the residual ink amount is a predetermined level or less.

1 57. The ink supply system as set forth in claim 56, wherein:
2 a plurality of detectors are provided with each subtank; and
3 the system controller starts to supply ink to the subtank when the
4 detection of one detector is effected, and stops the ink supply when the
5 detection of another detector is effected.

1 58. The ink supply system as set forth in claim 56, wherein the detector is
2 solely provided.

1 59. The ink supply system as set forth in claim 58, wherein the system
2 controller supplies ink to the subtank during the detection of the detector is
3 effected.

1 60. The ink supply system as set forth in claim 58, wherein the system
2 controller supplies ink to the subtank for a predetermined time period when the
3 detection of the detector is effected.

1 61. The ink supply system as set forth in claim 54, wherein:
2 each subtank is provided with at least one detector which detects a
3 residual ink amount therein and
4 the system controller stops the ink supply when the detection of the
5 detector is effected.

1 62. The ink supply system as set forth in claim 46, wherein the system
2 controller supplies ink from the main tank to each subtank every time when the
3 system is activated.

1 63. The ink supply system as set forth in claim 46, wherein the system
2 controller supplies ink from the main tank to each subtank every time when a
3 predetermined time period elapses.

1 64. The ink supply system as set forth in claim 46, wherein the system
2 controller supplies ink from the main tank to the subtank after obtaining the
3 consumed ink amount of each subtank to calculate a residual ink amount in the
4 main tank, every time when the recording section performs recording.

1 65. The ink supply system as set forth in claim 46, wherein:
2 the system controller obtains the consumed ink amount of each
3 subtank every time when the recording section performs recording to calculate
4 a residual ink amount in the main tank; and
5 an ink end state is effected in all the recording section when the
6 residual ink amount in the main tank is a predetermined level or less.

1 66. The ink supply system as set forth in claim 65, wherein the recording
2 section continues the recording until a predetermined amount of ink in the
3 subtank is consumed after the ink end state is effected.

1 67. The ink supply system as set forth in claim 46, wherein:
2 the system controller sequentially compares the ink amount
3 consumed in each subtank and a residual ink amount in the main tank;
4 the system controller supplies ink to the compared subtank when the
5 consumed ink amount of the compared subtank is less than the residual ink
6 amount; and
7 an ink end state is effected when the consumed ink amount of the
8 compared subtank is greater than the residual ink amount.

1 68. The ink supply system as set forth in claim 46, wherein:
2 the system controller sequentially compares the ink amount
3 consumed in each subtank and a residual ink amount in the main tank;
4 the system controller supplies ink to the compared subtank when the
5 consumed ink amount of the compared subtank is less than the residual ink
6 amount;
7 the system controller does not supply ink to the compared subtank
8 when the consumed ink amount of the compared subtank is greater than the
9 residual ink amount; and
10 an ink end state is effected when there is at least one subtank to
11 which ink is not supplied.

1 69. The ink supply system as set forth in claim 67, wherein the ink supply
2 is once performed even when the ink end state is effected.

1 70. The ink supply system as set forth in claim 67, wherein the ink supply
2 is performed until any change is not occurred in the detector, even when the
3 ink end state is effected.

1 71. The ink supply system as set forth in claim 56, wherein:
2 a valve member is provided between the main tank and each
3 subtank; and
4 the valve member is closed when the detector detects that the
5 residual ink amount is a predetermined level or more.

1 72. The ink supply system as set forth in claim 71, wherein each valve
2 member is closed independently from another valve members.

1 73. The ink supply system as set forth in claim 71, wherein each valve
2 member is closed selectively.

1 74. The ink supply system as set forth in claim 71, wherein all the valve
2 members are closed simultaneously.

1 75. The ink supply system as set forth in claim 74, wherein all the valve
2 members are closed when at least one detector among the detectors of the
3 subtanks detects that one subtank is almost empty.

1 76. The ink supply system as set forth in claim 46, wherein:
2 the main tank is provided with a first detector which detects a residual
3 ink amount in the main tank; and
4 an ink end state is effected when the first detector detects that the
5 residual ink amount is a predetermined amount or less.

1 77. The ink supply system as set forth in claim 76, wherein:
2 each subtank is provided with a second detector which detects a
3 residual ink amount therein; and
4 the system controller stops the ink supply when the second detector
5 detects that the subtank is almost full when the ink end state is effected.

1 78. The ink supply system as set forth in claim 46, further comprising a
2 memory for storing a residual ink amount in the main tank.

1 79. The ink supply system as set forth in claim 47, wherein each subtank
2 contains a plate member which prevents inner surfaces of the subtank from
3 being adhered with each other.

1 80. The ink jet recording apparatus as set forth in claim 79, wherein
2 grooves are formed on surfaces of the plate member.

1 81. A method of managing an ink amount supplied from main tank to the
2 subtanks which are provided in the ink system as set forth in any one of claims
3 46 to 80.

Sub
P26 82. The ink supply system as set forth in claim 45, further comprising a
memory for storing a residual ink amount in the main tank.

1 83. A method of managing an ink amount supplied from main tank to the
2 subtanks which are provided in the ink system as set forth in claim 45 or 82.